observation and documentation of neurologic status in the intraoperative and postoperative period may reveal signs of an intracerebral event. This case demonstrates that even a medically trained patient can be unwilling or unable to supply appropriate information during this period.

References

1. Welch K: Subdural hematoma following spinal anesthesia. Arch Surg 79:49–51, 1959
2. Pavlin DJ, McDonald JS, Child B: Acute subdural hematoma—an unusual sequela to lumbar puncture. ANESTHESIOLOGY 51:338–340, 1979
3. Schube PG, Raskin N: Cerebral hemorrhage following lumbar spinal puncture. J Nerv Ment Dis 84:636–659, 1936
4. Mantia AM: Clinical report of the occurrence of an intracerebral hemorrhage following post lumbar puncture headache. ANESTHESIOLOGY 55:684–685, 1981
5. Edelman JD, Wingard DW: Subdural hematomas after lumbar dural puncture. ANESTHESIOLOGY 52:166–167, 1980
6. Siegle JH, Dewan DM, Janes FM: Cerebral infarction following spinal anesthesia for cesarean section. Anesth Analg 61:390–392, 1982
7. Fleiss AN: Multiple sclerosis appearing after spinal anesthesia. NY St J Med 49:1076, 1949
8. Ghate SV, Kulkarni SE, Sarate GS: Hemiplegia and retrobulbar neuritis after subarachnoid block. Canad Anaesth Soc 28:283–284, 1981
9. Saha AL, Perret GE, Locksley HB, Nishioka H: Intracranial aneurysms and subarachnoid hemorrhage—a cooperative study, Philadelphia, JB Lippincott, 1969
10. Fox EJ, Sklar GS, Hill CH, Villanceva R, King BD: Complications related to the pressor response to endotracheal intubation. ANESTHESIOLOGY 47:524–525, 1977

Anesthesiology
59:477–479, 1983

Intrathecal Morphine for Relief of Labor Pain in a Parturient with Severe Pulmonary Hypertension

THERESE K. ABBOUD, M.D.,* JULIO RAYA, M.D.,† RABIA NOUEIHED, M.D.,‡ JAMES DANIEL, M.D.§

In women who have primary pulmonary hypertension,[1] maternal mortality is more than 50%[2] usually during labor or puerperium.[3] The hemodynamic features of this condition consist of pulmonary artery pressure higher than 30/15 mmHg,[2] right ventricular hypertrophy, and eventually failure and a low fixed cardiac output. Most complications arise from a decrease in systemic vascular resistance and reduction in venous return. For this reason, spinal or epidural anesthesia often is avoided in these patients.[4] Hyperbaric morphine injected intrathecally provides excellent analgesia during labor without any significant autonomic or motor effects.[5] We describe the labor and delivery in a patient with severe pulmonary hypertension who received intrathecal morphine analgesia.

* Associate Professor of Anesthesiology, Director of OB Anesthesia Research.
† Anesthesia Resident.
‡ Research Fellow in Obstetrical Anesthesia.
§ Assistant Professor of Clinical Anesthesia.

Received from the Women's Hospital, Los Angeles County-University of Southern California Medical Center, Los Angeles, California. Accepted for publication April 28, 1983.

Address reprint requests to Dr. Abboud: Department of Anesthesiology, LAC/USC Medical Center, P.O. Box 12, 1200 North State Street, Los Angeles, California 90033.

Key words: Heart: pulmonary hypertension. Anesthesia: obstetric. Anesthetic techniques: spinal; morphine.

Report of a Case

A 34-year-old woman, 155 cm, 67 kg, gravida 6, para 5, with primary pulmonary hypertension, was admitted at 38 weeks of gestation because of hemoptysis, dyspnea, and orthopnea. The patient had a chronic case of alcoholism and had a history of addiction to iv methylphenidate (Ritalin®) years ago, which was no longer an active problem, with the last use being 2 years before admission. She had no cardiopulmonary symptoms until 2 years before admission, which was also about 2 years after her last delivery. Symptoms began with decreased exercise tolerance, which progressed to orthopnea and later hemoptysis. Physical examination disclosed a grade IV/VI holosystolic murmur, best heard at the pulmonic area and apex. ECG showed right ventricular hypertrophy, right axis deviation, and left ventricular strain pattern. Chest roentgenogram revealed a prominent pulmonary artery. Right-sided cardiac catheterization revealed a pulmonary artery pressure (PAP) of 111/38 mmHg, with a mean of 64 mmHg, right ventricular pressure of 115/2 mmHg, and right atrial pressure (RAP) of 33 mmHg. While breathing room air, pH_a was 7.48, Pa_{O_2} 50 mmHg, Pa_{CO_2} 26 mmHg, and BE −3 mEq/l. Hematocrit was 39%, serum Na 139 mEq/l, and K 3.7 mEq/l.

Digoxin, diuretics, and potassium supplements were given by mouth and oxygen via nasal prongs. Spontaneous labor started 6 days after admission. PAP and RAP were measured using a flow-directed catheter. Cardiac output (CO) was measured by thermodilution. Systemic blood pressure was measured using an automated blood pressure monitor; blood gas and acid base variables and respiratory rate also were recorded. When the patient became uncomfortable (cervix 4 cm dilated) 1 mg of preservative-free morphine sulfate in 7.5% dextrose was injected at L_3-L_4 interspace using a 25-gauge spinal needle, with the patient in the lateral position. After injection, the patient was turned supine with her head elevated 30 degrees. The onset of analgesia occurred within 15 min, and within 30 min she was comfortable as

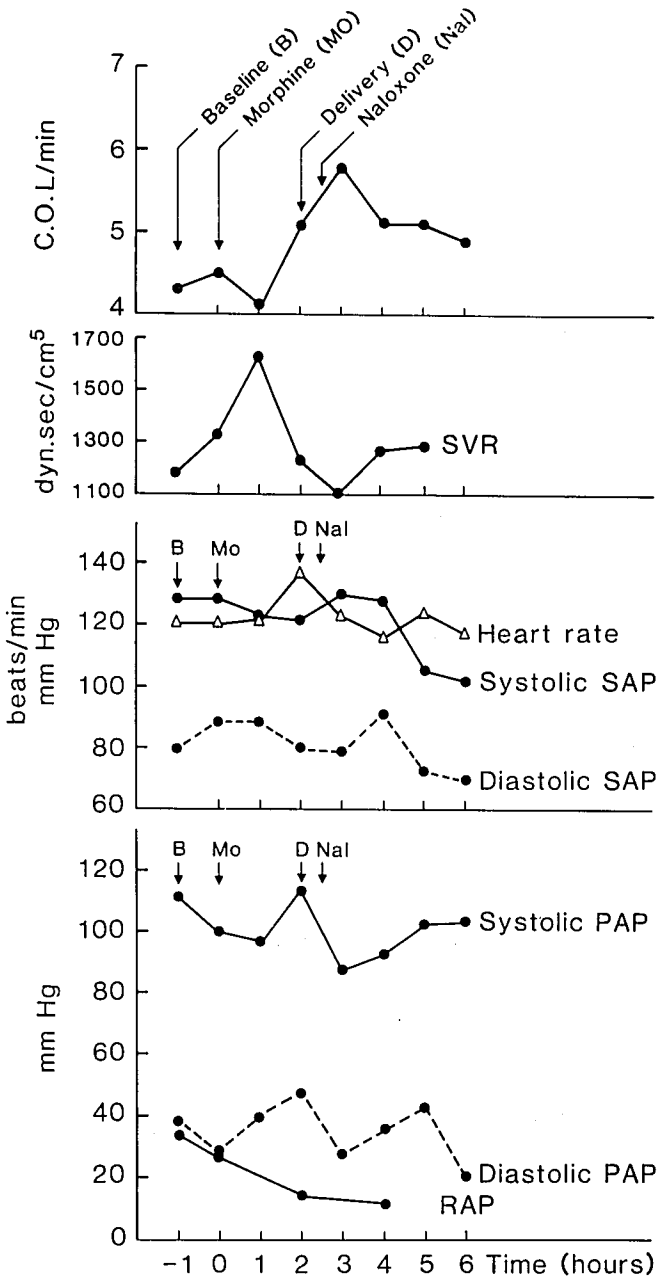

FIG. 1. Hemodynamic observations during vaginal delivery using intrathecal morphine analgesia in a patient with primary pulmonary hypertension. Values were obtained at the time of cardiac output measurement. CO = cardiac output; SVR = systemic vascular resistance; SAP = systemic arterial pressure; PAP = pulmonary artery pressure; RAP = right atrial pressure.

evaluated using the visual analog scale and the anesthesiologists' independent evaluation of pain intensity and pain relief. Intrathecal morphine was not followed by any significant changes in blood pressure, PAP, CO, as shown in figure 1. There was no respiratory depression as ascertained by analysis of blood gases and respiratory rate (table 1). No changes were noted in uterine activity or fetal heart rate following the injection of morphine. One hour after the injection, the patient had occasional mild pruritus of the nose that did not necessitate any treatment. Two hours after injection of the intrathecal morphine, a 2,400-gm female infant was delivered with the aid of forceps. Pudendal block anesthesia with 1% lidocaine, 15 ml, was used for delivery. Infant Apgar scores were 9 at both 1 and 5 min, and cord blood acid base status was within normal limits. Estimated blood loss during delivery was 400 ml. Following delivery, the patient complained of severe itching of the face and the trunk, which was treated successfully with initial iv bolus of 0.08 mg of naloxone, followed by a drip of 0.1 mg/h for 5 h. The patient then was transferred from the delivery room to the Coronary Care Unit for observation.

The postpartum course was mostly uneventful, with the exception of a hypotensive eposide that occurred 13 h postpartum. Blood pressure at that time was 85/60 mmHg, which responded to iv crystalloid therapy. Hemodynamic measurements were discontinued and the patient was transferred to the cardiology ward 3 days postpartum. At 7 days she was judged to be ready for discharge when she experienced chest pain, severe hypotension, and sudden cardiovascular collapse. All attempts at resuscitation were unsuccessful. The patient died 4 h later. Autopsy showed right heart hypertrophy and extensive atheromatosis in the pulmonary arteries.

DISCUSSION

Pain, anxiety, and stress are especially detrimental in patients with pulmonary hypertension because pulmonary vascular resistance may increase markedly. Regional anesthesia techniques may be associated with decrease in systemic vascular resistance and venous return.[4] Systemic analgesics may not be very effective in relieving labor pain, also, excessive doses may cause maternal hypercarbia and acidosis, with a resulting increase in pulmonary vascular resistance. In addition, neonatal depression from the narcotic also may result. Thirty-eight pregnancies have been described in 21 patients with primary pulmonary hypertension.[6-9] Eleven of these 21 patients (52%) died during pregnancy or the early postpartum period,[6-10] mostly because of sudden cardiovascular collapse. No mention was made of the anesthetic management of these patients. Only one report exists in which epidural anesthesia was administered during labor to a patient with severe pulmonary hypertension who also had sudden cardiovascular collapse and died on the ninth postpartum day.[11] Even though no hypotension due to the epidural block was observed, this technique was associated with a decrease in cardiac output and increase in pulmonary pressures, which indicate a progressive impairment of left ventricular stroke volume.[12]

Cause of death in our patient and in the later report by Sorensen *et al.*[11] was not entirely clear because controlled hemodynamic data or electrocardiographic information were unavailable. Worsening of the balance between myocardial oxygen and demand may lead to ischemia and consequently to right ventricular failure and fatal arrhythmias. Cause of death in this group of patients could be due to autotransfusion after delivery, right heart failure, increased pulmonary resistance, or a combination of all of these factors. Since the isolation of the opiate receptors[13-15] in the central nervous system,

TABLE 1. Analysis of Maternal Blood Gases

	6 Days before Delivery	3 Days before Delivery		Delivery	12 hr after Delivery	36 hr after Delivery
$F_{I_{O_2}}$	40%	20%	40%	60%	40%	40%
Pa_{O_2} (mmHg)	72	50	109	140	85	80
Pa_{CO_2} (mmHg)	26	26	22	26	25	26
pH_a	7.46	7.48	7.51	7.50	7.44	7.43
Base excess mEq/L	−5	−3	−5	−2	−7	−6
HCO_3 (mEq/l)	18	20	20	21	15	17
O_2 sat	98%	89%	97%	99%	97%	98%
Respiratory rate (min)	28	28	32	32	18	18

various reports have shown the effectiveness of small doses of intrathecal morphine in relieving the pain of labor.[5,16,17] A possible disadvantage of this technique is the high incidence of pruritus, nausea and vomiting, urinary retention and somnolence, and, on some occasions, delayed respiratory depression.

In our patient the only side effect encountered was pruritus, which was treated easily by the administration of naloxone. A possible advantage of this technique over other methods of pain relief in obstetrics is the selective analgesic effect without other sensory, motor, or autonomic side effects.[18] Intrathecal injection of morphine also has been used experimentally in the parturient rat and rabbit without any detectable effect on the viability of the newborn or the initiation and the progress of labor.[19] The small effective dose of intrathecally injected morphine and its slow release into the systemic circulation[19,20] may spare the fetus and result in selective maternal analgesia without adverse effects on the cardiovascular system.

We conclude that intrathecal morphine given to our patient provided good analgesia during labor, without causing any adverse effects on the cardiovascular or the respiratory system, but this technique did not change the unfortunate result for the patient. Prognosis might have been improved if monitoring had been continued postdelivery as a guide for treatment and intervention.

REFERENCES

1. Walcott G, Burcell HB, Brown AL: Primary pulmonary hypertension. Am J Med 49:70–77, 1970
2. Elkayam U, Gleicher N: Cardiac problems in pregnancy: Diagnosis and management of maternal and fetal disease. Edited by Elkayam U, Gleicher H, 1982, pp 153–160
3. Jewett JF, Ober WB: Primary pulmonary hypertension as a cause of maternal death. Am J Obstet Gynecol 71:1335–1341, 1956
4. Mangano DT: Anesthesia for the pregnant cardiac, Anesthesia for Obstetrics. Edited by Shnider SM, Levinson G. Baltimore, Williams and Wilkins, 1979, pp 197–200
5. Abboud TK, Shnider SM, Daily PA, Raya J, Khoo SS, Sarkis S, DeSousa B, Baysinger CL, Miller F: Hyperbaric intrathecal morphine for the relief of labor pain. ANESTHESIOLOGY 57:A384, 1982
6. McCaffrey RM, Dunn LJ: Primary pulmonary hypertension in pregnancy. Obstet Gynecol Surv 19:567–591, 1964
7. Pomaskin VA, Rosenfeld LI, Osipova SM: Primary pulmonary hypertension and pregnancy. Vopr Okhr Materin Det 13:80–82, 1968
8. Demas NW: Maternal death due to primary pulmonary hypertension. Trans Pac Coast Obstet Gynecol Soc 40:64–67, 1972
9. Salvin AG: Importance of hyperbaric oxygenation for a favorable outcome of labor in primary pulmonary hypertension patients. Vopr Okhr Materin Det 24:64–66, 1979
10. Giard P, Croccel L, Dutoit A: Idiopathic pulmonary hypertension with severe evolution following pregnancy. J Sci Med Lille 85:439–448, 1967
11. Sorensen MB, Korshin JD, Fernandes A, Secher O: The use of epidural analgesia for delivery in a patient with pulmonary hypertension. Acta Anesth Scand 26, 180–182, 1982
12. Laver M, Strauss HW, Pohost GM: Right and left ventricular geometry: Adjustments during active respiratory failure. Crit Care Med 7:509, 1979
13. Simon EJ, Hiller JM, Edelman I: Stereospecific binding of potent narcotic analgesia (^{3}H) etorphine to rat-brain homogenate. Proc Natl Acad Sci USA 70:1947–1949, 1973
14. Terenuis L: Characteristics of the "receptor" for narcotic analgesics in synaptic plasma membrane fraction from rat brain. Acta Pharmacol 33:377–384, 1973
15. Duggan AW: Morphine, enkephalins and the spinal cord, Advances in Pain Research and Therapy, vol. 3. New York, Raven Press, 1979, pp 449–458
16. Baraka A, Noueihed R, Hajj S: Intrathecal injection of morphine for obstetric analgesia. ANESTHESIOLOGY 54:136–146 1981
17. Scott PV, Bowen FE, Cartwright P, Mohan Rao BC, Deeley D, Wortherspoon EG, Sumrein IMA: Intrathecal morphine as a sole analgesic during labor. Br Med J 2:351–353, 1980
18. Alper MH: Intrathecal morphine: A new method of obstetrical analgesia (editorial). ANESTHESIOLOGY 51:378–379, 1979
19. Yaksh TL, Wilson PR, Kaiko RF, Inturriso CE: Analgesia produced by a spinal action of morphine and effects upon parturition in the rat. ANESTHESIOLOGY 51:386–392, 1979
20. Yaksh TL, Rudy T: Studies on the direct spinal action of narcotics in the production of analgesia. J Pharmacol Exp Ther 202:411–428, 1977